Amendment to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

In the claims:

1. (Currently Amended): A method of selecting a profile model for use in examining a structure formed on a semiconductor wafer using optical metrology, the method comprising:

a) obtaining an initial profile model having a set of profile parameters that characterize the structure to be examined;

b) training a machine learning system using the initial profile model;

c) generating a simulated diffraction signal for an optimized profile model using the trained machine learning system, wherein the optimized profile model has a set of profile parameters with the same or fewer profile parameters than the initial profile model;

d) determining if one or more termination criteria are met; and

e) if the one or more termination criteria are not met, modifying the optimized profile model by eliminating at least one profile parameter or fixing to a value at least one profile parameter and iterating steps c) to e) using the modified optimized profile model, wherein the same trained machine learning system is used in iterating step c).

2. (Original): The method of claim 1, further comprising:

obtaining a measured diffraction signal from an optical metrology device; and

analyzing the simulated diffraction signal and the measured diffraction signal.

3. (Original): The method of claim 2, wherein the one or more termination criteria includes a cost function value determined based on the analysis of the simulated and measured diffraction signals.

4. (Original): The method of claim 2, wherein the one or more termination criteria includes a preset goodness of fit (GOF) value determined based on the analysis of the simulated and measured diffraction signals.

5. (Original): The method of claim 1, further comprising:

obtaining a measured diffraction signal from an optical metrology device; and

obtaining a profile associated with the measured diffraction signal, wherein the one or more termination criteria includes parameter correspondence determined between the profile parameters of the optimized profile model and dimensions of the profile associated with the measured diffraction signal.

6. (Original): The method of claim 1, wherein the one or more termination criteria includes a correlation coefficient determined between a pair of profile parameters of the optimized profile model.

7. (Original): The method of claim 1, wherein the one or more termination criteria includes a sensitivity determined for a profile parameter of the optimized profile model.

8. (Canceled)

9. (Original): The method of claim 1, wherein step b) comprises:

training a first machine learning system using a set of training input data and a set of training output data,

wherein each of the training input data is a profile model having a set of profile parameters with the same profile parameters as the initial profile model, and

wherein each of the training output data is a diffraction signal.

10. (Original): The method of claim 9, wherein the set of training output data is generated based on the set of training input data using a modeling technique prior to training the first machine learning system.

11. (Original): The method of claim 10, wherein the modeling technique includes rigorous coupled wave analysis, integral method, Fresnel method, finite analysis, or modal analysis.

12. (Original): The method of claim 9, wherein training the first machine learning system comprises:

f) obtaining training input data;

g) generating a diffraction signal with the first machine learning system using the training input data;

h) determining if one or more termination criteria are met; and

i) if the one or more termination criteria are not met, iterating steps g) to i).

13. (Original): The method of claim 12, further comprising:

when iterating steps g) to i), adjusting the machine learning system or using new training input data in step g).

14. (Original): The method of claim 9, further comprising:

testing the first machine learning system using a second machine learning system.

15. (Original): The method of claim 14, further comprising:

before testing the first machine learning system, training the second machine learning system using the training input data for the first machine learning system as training output data for the second machine learning system, and the training output data for the first machine learning system as training input data for the second machine learning system.

16. (Original): The method of claim 15, further comprising:

after training the second machine learning system,

generating one or more simulated diffraction signals using one or more profile models as inputs to the first machine learning system;

generating one or more profile models using the one or more simulated diffraction signals generated by the first machine learning system as inputs to the second machine learning system; and

analyzing the one or more profile models generated by the second machine learning system and the one or more profile models used as inputs to the first machine learning system.

17. (Original): The method of claim 1, wherein the machine learning system is a neural network.

18. (Original): The method of claim 1, wherein the optical metrology device is an ellipsometer or reflectometer.

19. (Original): The method of claim 1, wherein the one or more profile parameters includes one or more of critical dimension measurements, angle of incidence, n and k values, or pitch.

20. (Original): The method of claim 1, further comprising:

if one or more termination criteria are met,

selecting at least one profile parameter of the optimized profile model; and

setting the at least one profile parameter to a determined value.

21. (Original): The method of claim 20, wherein the at least one profile parameter includes a thickness parameter, and wherein the determined value includes an average thickness measurement.

22. (Currently Amended): A computer-readable storage medium containing computer executable instructions for causing a computer to select a profile model for use in examining a structure formed on a semiconductor wafer using optical metrology, comprising instructions for:

a) obtaining an initial profile model having a set of profile parameters that characterize the structure to be examined;

b) training a machine learning system using the initial profile model;

c) generating a simulated diffraction signal for an optimized profile model using the trained machine learning system, wherein the optimized profile model has a set of profile parameters with the same or fewer profile parameters than the initial profile model;

d) determining if one or more termination criteria are met; and

e) if the one or more termination criteria are not met, modifying the optimized profile model by eliminating at least one profile or fixing to a value at least one profile parameter and iterating steps c) to e) using the modified optimized profile model, wherein the same trained machine learning system is used in iterating step c)..

23. (Original): The computer-readable storage medium of claim 22, further comprising:

obtaining a measured diffraction signal from an optical metrology device; and

analyzing the simulated diffraction signal and the measured diffraction signal.

24. (Original): The computer-readable storage medium of claim 23, wherein the one or more termination criteria includes a cost function value determined based on the analysis of the simulated and measured diffraction signals.

25. (Original): The computer-readable storage medium of claim 23, wherein the one or more termination criteria includes a goodness of fit (GOF) value determined based on the analysis of the simulated and measured diffraction signals.

26. (Original): The computer-readable storage medium of claim 22, further comprising:

obtaining a measured diffraction signal from an optical metrology device; and

obtaining a profile associated with the measured diffraction signal, wherein the one or more termination criteria includes parameter correspondence determined between the profile parameters of the optimized profile model and dimensions of the profile associated with the measured diffraction signal.

27. (Original): The computer-readable storage medium of claim 22, wherein the one or more termination criteria includes a correlation coefficient determined between a pair of profile parameters of the optimized profile model.

28. (Original): The computer-readable storage medium of claim 22, wherein the one or more termination criteria includes a sensitivity determined for a profile parameter of the optimized profile model.

29. (Canceled)

30. (Original): The computer-readable storage medium of claim 22, wherein step b) comprises:

training a first machine learning system using a set of training input data and a set of training output data,

wherein each of the training input data is a profile model having a set of profile parameters with the same profile parameters as the initial profile model, and

wherein each of the training output data is a diffraction signal.

31. (Original): The computer-readable storage medium of claim 30, wherein the set of training output data is generated based on the set of training input data using a modeling technique prior to training the machine learning system.

32. (Original): The computer-readable storage medium of claim 30, further comprising:

testing the first machine learning system using a second machine learning system.

33. (Original): The computer-readable storage medium of claim 32, further comprising:

before testing the first machine learning system, training the second machine learning system using the training input data for the first machine learning system as training output data for the second machine learning system and the training output data for the first machine learning system as training input data for the second machine learning system.

34. (Original): The computer-readable storage medium of claim 33, further comprising:

after training the second machine learning system,

generating one or more simulated diffraction signals using one or more profile models as inputs to the first machine learning system;

generating one or more profile models using the one or more simulated diffraction signals generated by the first machine learning system as inputs to the second machine learning system; and

analyzing the one or more profile models generated by the second machine learning system with the one or more profile models used as inputs to the first machine learning system.

35. (Original): The computer-readable storage medium of claim 22, further comprising:

if one or more termination criteria are met,

selecting at least one profile parameter of the optimized profile model; and

setting the at least one profile parameter to a determined value.

36. (Original): The computer-readable storage medium of claim 35, wherein the at least one profile parameter includes a thickness parameter, and wherein the determined value includes an average thickness measurement.

37. (Currently Amended): A system to select a profile model for use in examining a structure formed on a semiconductor wafer using optical metrology, the system comprising:

an optical metrology device configured to provide a measured diffraction signal;

a first machine learning system trained using an initial profile model having a set of profile parameters that characterize the structure to be examined, the first machine learning system configured to generate a simulated diffraction signal for an optimized profile model having a set of profile parameters with the same or fewer profile parameters than the initial profile model,

wherein if one or more termination criteria are not met, the optimized profile model is modified by selecting at least one profile parameter of the optimized profile model to eliminate or fix to a value and the first machine learning system generates another simulated diffraction signal using the modified optimized profile model.

38. (Original): The system of claim 37, wherein the one or more termination criteria includes a cost function value or a goodness of fit (GOF) value determined based on an analysis of the simulated and measured diffraction signals.

39. (Original): The system of claim 37, wherein a profile associated with the measured diffraction signal is obtained, and wherein the one or more termination criteria includes parameter correspondence determined between the profile parameters of the optimized profile model and dimensions of the profile associated with the measured diffraction signal.

40. (Original): The system of claim 37, wherein the one or more termination criteria includes a correlation coefficient determined between a pair of profile parameters of the optimized profile model.

41. (Original): The system of claim 37, wherein the one or more termination criteria includes a sensitivity determined for a profile parameter of the optimized profile model.

42. (Canceled)

43. (Original): The system of claim 37, wherein the first machine learning system is trained using a set of training input data and a set of training output data, wherein each of the training input data is a profile model having a set of profile parameters with the same profile parameters as the initial profile model, and wherein each of the training output data is a diffraction signal.

44. (Original): The system of claim 43, further comprising:

a second machine learning system trained using the training input data for the first machine learning system as training output data for the second machine learning system, and the training output data for the first machine learning system as training input data for the second machine learning system.

45. (Original): The system of claim 44, wherein

one or more simulated diffraction signals are generated using one or more profile models as inputs to the first machine learning system;

one or more profile models are generated using the one or more simulated diffraction signals generated by the first machine learning system as inputs to the second machine learning system; and

the one or more profile models generated by the second machine learning system are compared with the one or more profile models used as inputs to the first machine learning system.

46. (Original): The system of claim 37, wherein the first machine learning system is a neural network.

47. (Original): The system of claim 37, wherein the optical metrology device is an ellipsometer or reflectometer.

48. (Original): The system of claim 37, wherein the one or more profile parameters includes one or more of critical dimension measurements, angle of incidence, n and k values, or pitch.

49. (Original): The system of claim 37, wherein if one or more termination criteria are met, at least one profile parameter of the optimized profile model is selected and set to a determined value.

50. (Original): The system of claim 49, wherein the at least one profile parameter includes a thickness parameter, and wherein the determined value includes an average thickness measurement.